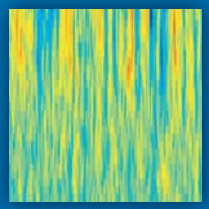
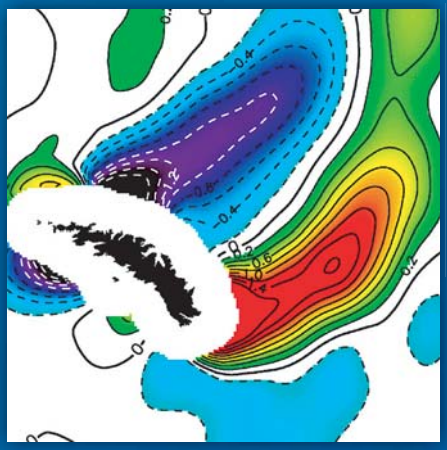
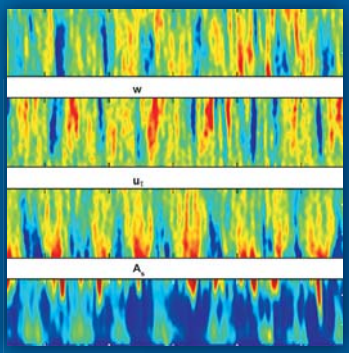
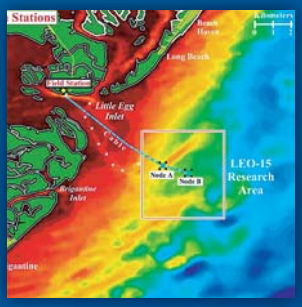
SCIENTIFICALLY SPEAKING









Tips for Preparing and Delivering Scientific Talks and Using Visual Aids

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INTRODUCTION

From graduate school to retirement, giving presentations is part of the fabric of scientific life. In the course of that life, scientists generally progress from "entrance" poster presentations, to short oral presentations, to longer invited lectures. Although the first edition of this booklet focused on the latter, this version addresses all three forms of presentation because each has its own challenges—challenges that must be identified and met if effective scientific communication is to happen.

Although scientific presentations are an accepted means of accomplishing the exchange of knowledge and information that is essential to scientific endeavor, many posters are ineffective communication tools and far too many bad talks are still being given. If presentations are not of the highest caliber in both content and delivery, communication is flawed and science is neither properly served nor facilitated. Development of good public speaking skills will also make positive contributions to many other aspects of an individual's career, given the importance of oral communication in other scientific situations, such as committees, boards, and public-policy discussions.

If presentations are not of the highest caliber in both content and delivery, communication is flawed and science is neither properly served nor facilitated.

To improve the flow of information among scientists, this publication attempts to provide advice and observations on preparing and delivering scientific presentations, taking these in career order, starting with poster presentations and moving on to oral presentations, both short and long. Many of the oral presentation points will apply to any public speaking situation, although others are unique to a scientific environment. We hope that the material assembled here will be of value to the scientific community. Future posters and talks will tell.

POSTER PRESENTATIONS

Since the first edition of this booklet was published in 1995, poster presentations have become the norm throughout scientific careers, but most particularly at the early career stages when (positive!) attention at meetings can lead to the postdoc or job of your dreams. Although fancy graphics are certainly no substitute for content, realize that for maximum effectiveness, posters require not only scientific care, but also graphics flair.

Anyone who has entered a meeting room filled with 200+ posters subconsciously realizes the first important thing a poster must do for its presenter:

GRAB ATTENTION!

To grab attention, at least some (ideally all) of your title should be in type large enough to be read from 6-7 m away. To make room for this attention-getting device:

- Choose a short title (!)
- Use a smaller font for the poster author(s), an even smaller one for associated institutional information (and abbreviate this—no one needs your street address).
- Leave out institutional "brands" or logos

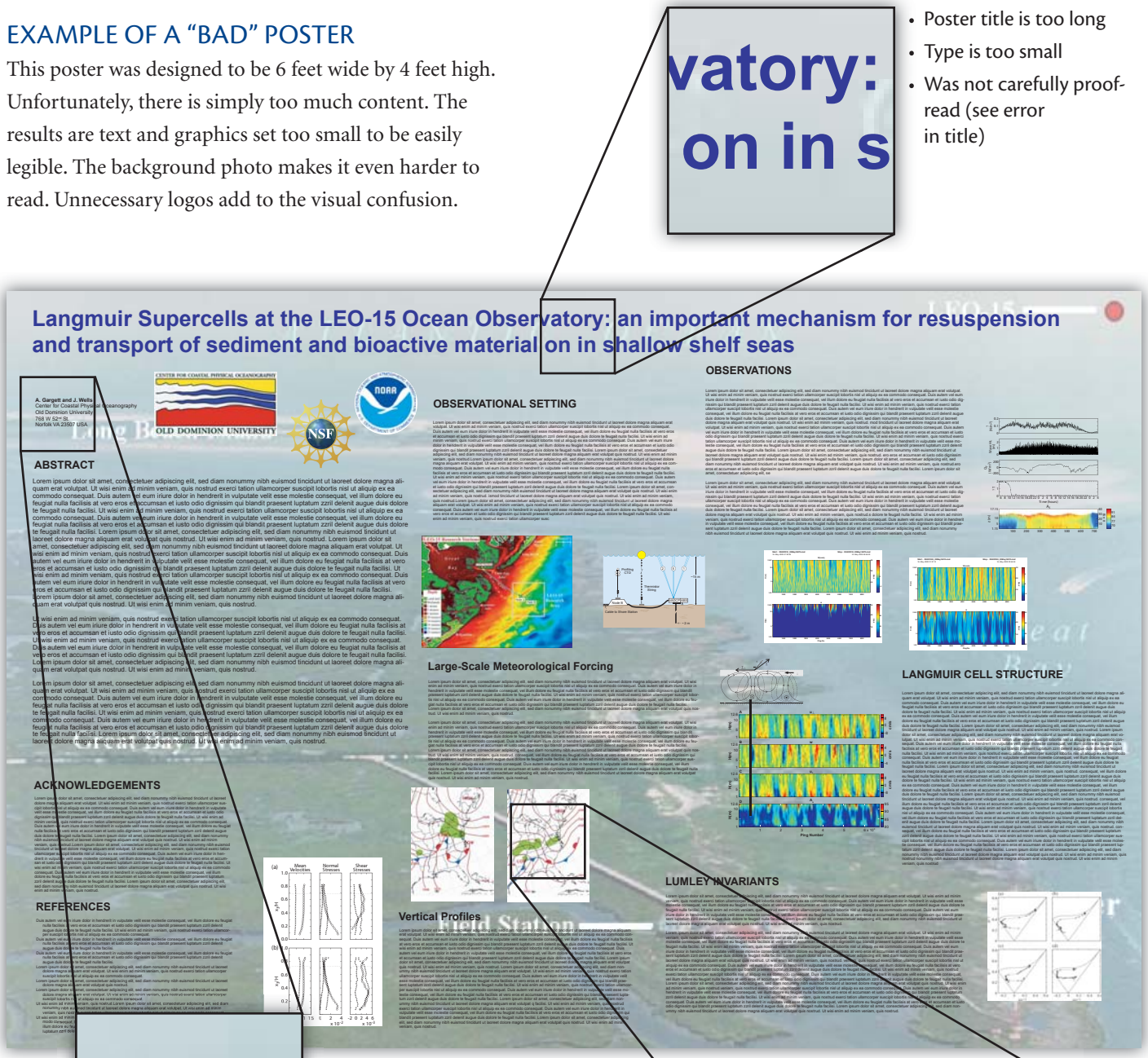
The second important thing a poster must do . . .

DELIVER YOUR MESSAGE QUICKLY!

This point is less obvious, but equally true in the era of television sound bites, Internet surfing, and decreased attention spans. Ask yourself how much time *you* are willing to spend trying to grasp the importance of science in a poster when the presenter is absent (which happens a lot—people often cruise poster sessions before and after any allotted presentation time). If it's longer than 2-3 minutes, you're pretty unusual.

EXAMPLE OF A "BAD" POSTER

This poster was designed to be 6 feet wide by 4 feet high. Unfortunately, there is simply too much content. The results are text and graphics set too small to be easily legible. The background photo makes it even harder to read. Unnecessary logos add to the visual confusion.



- Poster title is too long
- Type is too small
- Was not carefully proof-read (see error in title)

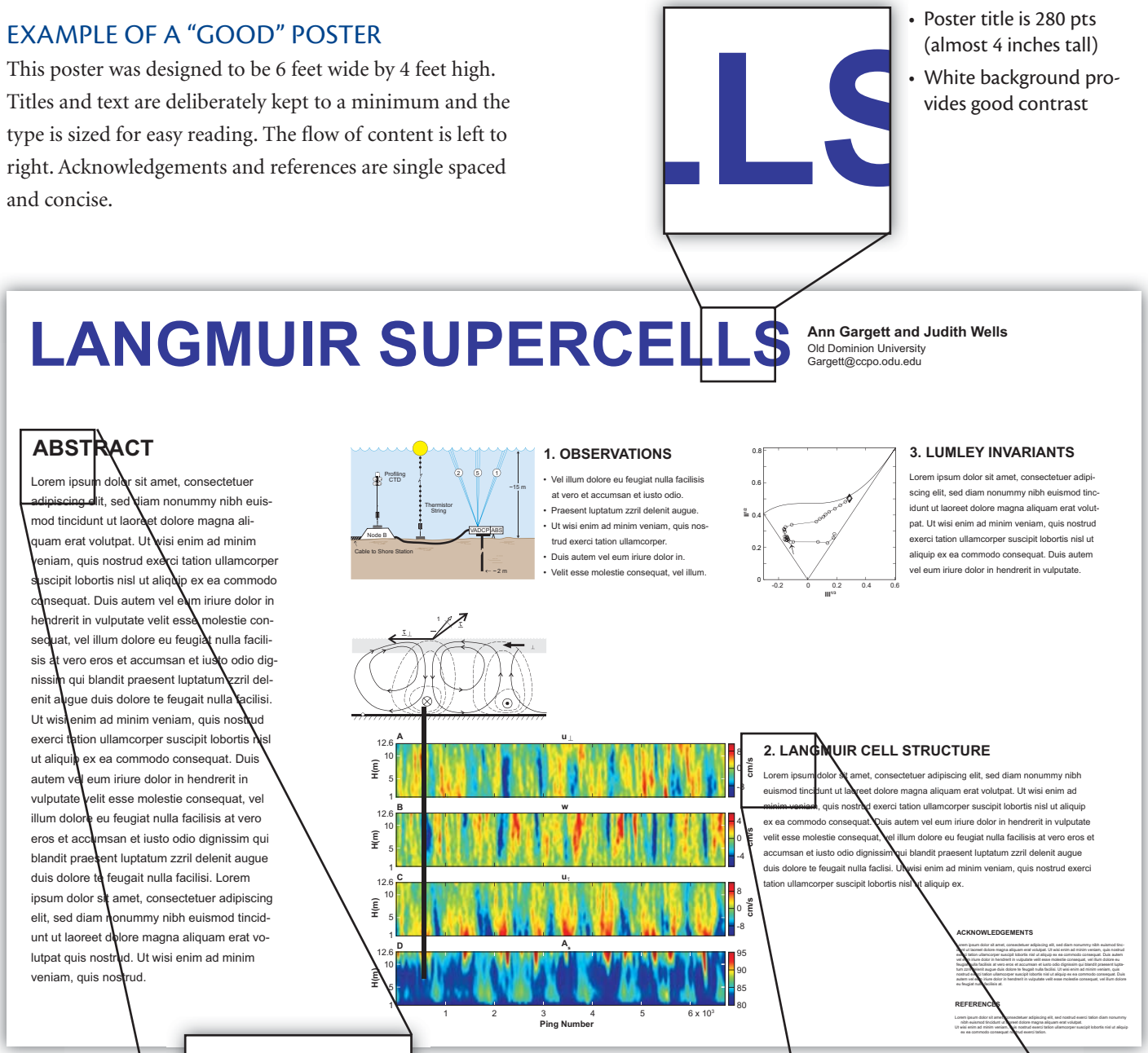
A. Gargett and J. Wells
Center for Coastal Physic
Old Dominion University
768 W 52nd St.
Norfolk VA 23507 USA

- Author names are too small
- First names should be given
- The full address is not necessary
- E-mail address should be given for contact info

- A poor-quality or low-resolution graphic makes the poster unprofessional

EXAMPLE OF A "GOOD" POSTER

This poster was designed to be 6 feet wide by 4 feet high. Titles and text are deliberately kept to a minimum and the type is sized for easy reading. The flow of content is left to right. Acknowledgements and references are single spaced and concise.



- Poster title is 280 pts (almost 4 inches tall)
- White background provides good contrast

- Title is 100 pts
- Text is 55 pts, double-spaced

- Title is 65 pts
- Text is 40 pts, double-spaced

So, within this short time, the poster must at least convey your basic message. At best, it should also engage the interest of the viewer enough that they are willing to invest more of their time in you and your work. Certain steps will help you to design a poster that fulfills both of these functions.

- Choose only ONE essential concept to address in the poster.
- Write a concise abstract that communicates what you have learned about this one concept and how it relates to a larger picture of your field. This abstract need not be identical to the one you submitted so many months previously in order to be accepted to the meeting. It *does* need to transmit the important point of your poster to the (typical) viewer who only reads the abstract and glances at the figures.
- Display this abstract prominently, in print large enough to be read from 2-3 m away.

Up to this point, the action of an effective poster is like that of a fisherman who first hooks a fish, then reels it in for a closer encounter. Once the viewer's attention has been both hooked and engaged, you want to make the most of their encounter with you and your poster. Some general suggestions for efficient transmission of information by poster encounter:

- Use first names in the list of poster authors and add e-mail information for the lead author. First names facilitate informal interaction with you, the presenter, if you are there. If you're not, an e-mail address makes it possible to contact you.
- Keep text to an absolute minimum. Write what you think *is* the absolute minimum, then force yourself to cut it in half. Continually remind yourself "There is ALWAYS too much text in a poster."
- Tell your story with graphics as much as possible. An efficient way to structure a poster presentation is to choose the graphics first, then write the "story" and arrange the spatial flow of the poster around them. As with text, a few well-chosen and large graphics are more effective than 10-12 smaller ones. Use of a few colors is effective: overuse of color is not. Size your graphics so they are easily visible from 2-3 m (a good visual is another "hook").

A poster must at least convey your basic message within two to three minutes. At best, it should also engage the interest of the viewer enough that they are willing to invest more of their time in you and your work.

- Make your poster easy on the eyes. If something is easy to read, it is more likely to *be* read. To increase your chances of being read, we suggest the following graphics "best practices":
  - Use black type on a pale background, either a solid color (or white) or a *subtle* texture/photograph. Intensely colored "busy" backgrounds suck attention from poster content and make it difficult to read the superimposed text, tiring the viewer.
  - Design simple flow paths. Complex paths from one element of your poster to another make it hard for the reader to follow the logical flow of your ideas in your poster: disorganized posters reflect badly on your scientific thinking.
  - Double-space all text except things like acknowledgments and references.
  - Use left-justification, shown to be easiest to read.
  - Use 18 pt minimum for text, larger for headings
  - Use a sans-serif font, like Arial or Helvetica, also shown to be easier to read than serif fonts like Times: be font-consistent throughout the poster.

In the end, we learn from what works. Go through the next poster session you encounter answering the questions—what hooked me? What made me willing to be netted? What did I get from a "good" encounter with a presenter? Could I have gotten at least their basic message from their poster if the presenter hadn't been there?

ORAL PRESENTATIONS

Studies show that we retain much more of what we see than what we hear. If so, why give oral presentations at all? Why not simply prepare handouts, distribute them to an audience, wait while the information is read, and call for questions? In fact, why have meetings at all? With the advent of electronic presentation tools and high-speed Internet connectivity, why don't we just have virtual meetings? There are several reasons besides "that's just the way it's done." The primary reason is that studies also show that we retain best what we both see and hear together. A scientific talk is an opportunity to both show *and* tell. If done properly, it provides your audience with knowledge presented in a way that best enables them to absorb and retain it.

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Thinking about *why* you give an oral presentation helps in defining *how* to give a good talk.

- Oral presentations are interactive experiences between the audience and the speaker. The speaker presents herself or himself, as well as the talk, to the audience. The speaker and the audience exchange signals. A speaker brings the subject to life for the audience through personal involvement and familiarity with it. Good interaction with the audience helps the delivery and aids the retention of the material by the audience.
- The audience has an opportunity to "meet" the speaker. For some members of the audience, there can be excitement in personally hearing a recognized authority in a given field. An introduction to a newcomer or lesser-known individual with something innovative and relevant to discuss is always interesting.

THE COMMITMENT

Agreeing to give a scientific talk of whatever length implies a significant commitment to the audience. If you are not willing to make this commitment, *you should not speak*. Your commitment—to make your best effort to be both interesting and informative—includes proper preparation of your talk and visual aids, as well as attention to delivering your message in the most effective way possible. It is easy to identify the speaker who is genuinely pleased to have the opportunity to share ideas and appreciates the audience's time and attention. This speaker skillfully and confidently delivers a clear, concise talk that is responsive to the audience's needs and level of understanding. An audience is entitled to expect that respect from every speaker.

We have all seen scientists who apparently believe that the science they present when speaking in a professional environment is all that is important ("the data speak for themselves" syndrome). Nothing else matters if it is "good science." They are scientists, not show people, right? Wrong. You have to be both for the audience to absorb and retain the most from your scientific presentation. You present yourself as well as the subject matter every time you stand in front of an audience. This is not to say that a polished delivery is more important than content, but how well you present your material directly impacts how well it is received. Acknowledging this fact is a large part of the commitment you make in agreeing to speak.

When addressing your peers and colleagues, it is in your best professional interest to take the commitment seriously. Bad talks reflect poorly on your competence and/or demonstrate an enormous ego and disregard for your audience, any and all of which will not improve your standing within your professional community.

Remember—giving a good scientific talk is never effortless.

PREPARATION

The *Book of Lists* tells us that public speaking is the number one human fear (death is sixth). Of all speaking situations, professional talks can understandably be the most stressful because colleagues, peers, current and potential bosses, and funding-agency representatives will be judging you and your presentation. Having reminded you why any sane individual is justifiably anxious when faced with giving a scientific talk, we will also remind you that with proper preparation you can make certain that your time at the lectern will be a professional asset. We stress preparation here because it is an area of extreme vulnerability in scientific talks. Familiarity with your subject and confidence in your research is not enough to give a good oral presentation. Those factors can, in fact, work against giving a good talk. They can produce a false sense of security, make you careless in your preparation, and let you take too much for granted with your audience.

You are speaking because you have knowledge worth sharing; however, effective communication of this information requires that you are a reasonably competent public speaker. The principles of good public speaking apply to scientific presentations as much as they do to political rallies or testimonial dinners. Speakers who believe their credentials and knowledge of the topic negate the need for proper preparation and the development of public speaking skills can convey only part of their messages. If your talk is not well prepared and you do not deliver it in a manner that gains and holds the attention of your audience, much of the knowledge you hope to share will be lost.

ASSESSING THE AUDIENCE

An extremely important part of effectively communicating what you know is tailoring your presentation to your audience's needs and level of understanding. The first step in preparing an invited oral presentation, then, is to learn as much as possible about your audience. This will often be self-evident, but if in doubt, ask questions.

- How large will the group be?
- Are they experts in your field?
- If a combination of experts (colleagues in your specific field) and non-experts (all others), what is the anticipated ratio?

If your talk is not well prepared and you do not deliver it in a manner that gains and holds the attention of your audience, much of the knowledge you hope to share will be lost.

- If a group of non-experts, what are the expected ranges of age and educational level?

It is much easier to speak to either all experts or all non-experts. If the entire audience is expert in your field, you speak to them as insiders and have an opportunity to dazzle and excite them with your knowledge and enthusiasm. If it is a group of non-experts, you can still dazzle and excite them, but you must adjust the scope and level of your material (which may require a lot more thought, effort, and time than you might anticipate!).

This publication is aimed primarily at scientists giving talks to other scientists. Please see the section entitled "Addressing a Nonscientific Audience" for a few pointers on giving a scientific talk to a lay audience or the media.

FITTING INTO THE PROGRAM

The amount of effort you make to fit into a particular program depends on whether your talk is self-inflicted (i.e., submitted) or invited. For both, the first essential is to verify the date, time, and place of the talk and how long you will have to speak. Mark the speaking date on your calendar when you commit to a talk, along with any other deadlines associated with the speaking engagement. That sounds completely obvious, but many can tell you of the embarrassment and irritation resulting from misunderstandings or forgotten commitments. For any talk, the likely size and layout of the presentation room is important information to have available before preparing visual aids.

Other than choosing an appropriate session for your presentation, little effort is required to fit into the program if you are giving a submitted talk. However, in preparing for an invited talk, it is important to have a clear understand-

ing of how your talk will fit into the total program and how it should mesh with any other related presentations. It is unnerving to hear the speaker(s) before you cover much or most of the material you intended to cover or to have prepared an introductory talk and learn only minutes before you take the podium that you are responsible for the summary and conclusion. Request a written confirmation of the details to verify what is expected if you don't receive it as part of your invitation to speak. You may also want to ask the organizers various questions about the program:

- Is the program focused on one discipline or is it designed to give a cross-disciplinary or multidisciplinary view of the topics?
- Will there be other talks on similar or related subjects?
- At what point in the program will your talk be given?
- Is a written summary of your talk or abstract required?

If you are to be the first speaker in a series of talks on related subjects, your presentation can appropriately include definitions, underlying assumptions, historical background, or other introductory material. If you are the final speaker in the series, summaries and conclusions are appropriate. If you are a middle speaker, it is reasonable to assume that the introductory material will have been covered before you reach the podium. To be on the safe side, however, it is wise to have a few notes to help you quickly fill any possible gaps.

Extra challenges are presented to speakers who are slotted right before lunch, right after lunch, at the end of the day and at the end of the meeting. These are times when a dash of the theatrical or some humor is helpful in capturing and holding the audience's attention, but don't overdo it.

CONTENT

Before you can begin drafting a talk, you must define the purpose, topic, and appropriate depth and scope of the information you will be presenting.

- The primary purpose of the scientific talk is to inform or instruct. You may also subtly try to persuade and even entertain your audience, but don't lose sight of the primary purpose.
- Your topic is defined by your invitation to speak or within the context of the meeting session to which it is contributed. As well, your topic may be influenced by the context of the rest of the program/session.
- The depth and scope of the scientific content are determined in large part by the audience profile and, most importantly, by the time allotted you.

Many scientific speakers make the mistake of overlooking the fact that effective communication requires both the sending and receiving of information. Part of the speaker's job, then, is to help put the audience in the "receive mode." A good speaker's fascination with the subject is transmitted to the audience and captures their interest to gain their full attention. In preparing your talk, ask yourself a few questions. Incorporating the answers into your talk will help you bring your subject to life and make your talk worthwhile and memorable.

For talks of all lengths:

- Why would other scientists be interested?
- How might other disciplines or other research areas within my own discipline use this information?

For longer talks and/or more diverse audiences:

- How can I generate excitement for my subject in someone without knowledge and involvement?
- Is there a research or teaching anecdote I could include for emphasis, added interest, or humor?

The hallmark of any successful scientific talk is clarity. To achieve clarity, the talk must be well organized and logically structured. It should have an introduction, a body, and a conclusion. The language must be concise. Audiences are annoyed, irritated, and frustrated by talks they cannot understand. You may have something important to say, but audiences will seldom struggle to find it.

Inexperienced speakers often make the mistake of trying to cover far too much material and providing excessive detail in one talk. They are also prone to overly long introductions and spending too much time discussing methods. It is generally wise to edit your introduction ruthlessly. Give only absolutely necessary details regarding methods (unless of course your talk is about methods). Narrow the focus rather than try to cover a large complex topic with generalities in a short period. Even when the program specifically calls for an overview, pull out one or two points to discuss in as much

An extremely important part of effectively communicating what you know is tailoring your presentation to your audience's needs and level of understanding.

detail as time permits. If you showcase one or two points that support or exemplify the generalities, your talk will be much more interesting and more easily retained.

Mathematical equations and symbols do not inevitably strengthen the science of a scientific talk: they *do* inevitably slow the pace of the talk, make it harder to understand (even for experts), and create an opportunity for confusion, the opposite of clarity. Many people, even mathematically trained scientists, tune out when math is introduced into a talk. If equations, calculations, and symbols are absolutely essential for understanding your topic, consider preparing handouts for later study. You can then concentrate on explaining the relevance of the mathematics and symbols rather than using your allotted time at the lectern on the equations and their solutions. If you must use mathematics in your presentation, slow down and talk your audience through each equation, step by step. Do not assume each individual can find a way through it and grasp the relevance.

Although scientific topics are serious, a little politically correct humor or an occasional light touch can vary the rhythm and significantly add to the audience's favorable reaction and memory of your talk. Don't go overboard, however, nor use this time to debut your stand-up comedy routine.

DRAFTING THE TALK

There are mixed views on whether or not it is advisable to write out every word you plan to say.

Those opposed to a complete written draft offer the following argument. In some nonscientific environments it is quite acceptable to read a prepared talk verbatim. The accepted style in scientific meetings, however, is to convey that you are completely familiar and comfortable with your material and that you are able to speak more or less extemporaneously on your subject. A few notes or an outline and some visual aids should suffice for those who know what they are talking about. A word-for-word draft may inhibit that conversational style. This approach probably does work for some, but it is quite risky for many of us, particularly public speaking neophytes, asked to speak clearly and concisely on a specific topic for a specified time.

Proponents of a complete written draft maintain that the exercise can greatly improve the effectiveness of any speaker. The primary objective of a scientific talk is clarity, which is achieved through concise language, logical sequence, and careful organization. A rich vocabulary facilitates the painting of vivid, attention-grabbing word pictures. Such precision, order, and verbal vibrancy can be accomplished far better with written language than with informal speech. This original draft needn't be overly constrained by the strict rules of written English or the formal academic style of scientific papers because the next step in the drafting process is to translate the written science into spoken science—two quite different things. It is difficult to captivate an audience with a talk given in "scientific journalese." With a well-prepared written draft you can fine-tune and rehearse your talk into a dynamic, vital presentation, complete with the desired conversational style.

If the latter method of preparation appeals to you more than the casual approach of the first method, write out your complete talk, practice it, then whittle it down to outline form or notes to take to the lectern. Your visual aids can also serve as notes, but be careful not to fall into the trap of merely reading your visual material to the audience in lieu of giving the talk You want your audience to remember you as a "value-added" speaker—one whose presence at the lectern made the presentation much more powerful than your PowerPoint file.

Consider the following guidelines in drafting and editing your talk.

- A good talk has an introduction, a body, and a conclusion. Make every word count.
- Remember you are writing for the ear, not the eye. People do not speak the way they write.
- Use simple, direct, active words.
- Strive to keep the non-technical language as straightforward and uncomplicated as possible.
- Simplify your phrases.
- Tighten your sentences.
- Never use a long word when a short one will do.

- If it is possible to delete a word without losing meaning, delete it.
- Use equations, math, and symbols sparingly and carefully.
- Almost by definition, scientific talks contain many facts and data, so it is a good idea to summarize. Summaries can be done as you progress through your talk or at the end, when visual summaries are particularly effective.

DEATH (OR WORSE) TO THOSE WHO RUN OVERTIME

It is rude and egotistical to exceed your allotted time. Running overtime also suggests a lack of preparation and experience. A good chairperson can justifiably be quite abrupt with a speaker who exceeds the allotted time.

Defining the scope and roughly organizing your material to fit within the specified time are among the first steps in preparing your talk. Granted, it is difficult to edit what might represent a life's work into 20 to 30 minutes, or a year's research in to 9 minutes: but remember that other speakers face the same dilemma and most somehow manage it. Conversely, many inexperienced speakers wonder, "How on earth can I possibly have enough to say to fill 20 to 30 minutes?" To avoid the humiliation of appearing to have little worthwhile to contribute, they prepare overly long talks and do not rehearse enough to get the timing right.

Never try to squeeze your 30-minute talk into a 20-minute speaking slot. Speaking as fast as you can and flashing through your visual material at the speed of light is not the way to condense your talk into the specified time. Your audience will be annoyed and will absorb little of your presentation.

While particularly challenging for inexperienced speakers, the short talk is something scientists continue to face throughout their careers because this format is typical for submitted presentations at most large scientific meetings. The short time allocated (typically 8-9 minutes with an additional 1 minute for questions) makes this the most difficult talk to prepare for. The short talk forces you to assemble your talk carefully, to be a severe editor of your words, and to be an exacting critic of your visual aids. Every word must count. Every table, equation, or figure must specifically and significantly contribute to the points you are covering. Good editing skills and objective scrutiny of your visual aids are essential to preparing a good short talk. However, they are talents that are well worth acquiring, as they will serve you well in preparing all your oral presentations.

Many public speaking authorities recommend preparing a talk that is slightly shorter than your allotted time. When you reach the podium, you may need the extra time to adjust the microphone, respond to the person who introduced you, or make an ad hoc comment about a preceding talk. It is better to conclude with a little time left over than to rush at the end (when you are making your final points or summarizing, or, heaven help you, running overtime).

One useful technique to help stay within your allotted time is to have one visual piece that can be shown at any time and used to deliver your closing message or summary. It should take no more than one minute to get through. When you are one minute from your time limit, show this piece. Introduce it by saying something to the effect, "If you continue with the details or data as I have been describing them, you finally arrive at this clear set of conclusions."

Whether you run out of time or not, *never, never* close your talk by saying, "I think I'll stop here." This phrase sends a loud and clear message that you have not adequately prepared. A few, brief words of conclusion or summary are far better than leaving your audience thinking that you just ran out of steam or lost interest in your subject.

PRACTICE, PRACTICE, PRACTICE

Accomplished public speakers advise that rehearsals are almost as important to a good oral presentation as the actual content of the talk.

It is not enough to read through your talk a couple of times. Things that read well can sound awkward. Speaking aloud, preferably while standing in front of some type of audience (spouse, friend, or colleague) who will give you honest, constructive feedback, will help you find the rough spots so you can smooth them out before you are on the podium. Rehearsals, with visual aids, are also utterly essential to timing your talk properly. Your goal is to achieve the comfortable, confident, conversational style considered good form in scientific circles without running overtime.

Another valuable rehearsal technique is to tape-record your talk. Listen to the entire presentation without your notes. Do your thoughts flow logically? Are the transitions

smooth? Do you vary your voice and your pace for emphasis, to avoid monotony, and as you transition to new thoughts? Do you hear any "ers," "ahs," or "ums"?

Videotaping a practice session is the Rolls Royce of rehearsal techniques. Many people loathe seeing (or hearing) themselves on tape. It does take more time and effort, but it is a guaranteed method for polishing your presentation to award-winning quality. Run the tape first and just listen, as though to a voice tape (above). Run it again and watch for these things: Do you make eye contact? What are your hands doing? Do you smile occasionally? How is your posture? Do you notice any distracting mannerisms? This method of critiquing your presentation, while somewhat painful, is brutally honest and therefore extremely valuable.

Accomplished public speakers advise that rehearsals are almost as important to a good oral presentation as the actual content of the talk.

Practice with your visual aids. In most scientific meetings, PowerPoint presentations are now the norm, freeing the speaker from the need to physically manage transparencies (although adding a new set of challenges to communication—see "Electronic Presentation Pitfalls"). However, you should practice pointing to the image on the projection screen, then turning back to the audience to speak. Do not talk to the screen! If possible, practice your talk in a room that is close to the size of the room in which you will deliver it.

It is important to rehearse a talk that you have given before, especially if some time has elapsed since you last gave it. Concentrate on making it sound fresh and new, for your sake and that of anyone in the audience who may have heard it before. Check information in the text and in your visual aids that may need updating.

If a speaker-ready room is provided, use it! Practicing in the actual presentation room is best. You may have practiced your talk fifty times at home or in the office, but you can benefit enormously from one last run through in the actual presentation room or one similar to it. Such a rehearsal will provide several benefits:

- You will have an opportunity to view your visual aids from the rear of the room to determine if they will be clearly visible to the entire audience. If any are dim, blurred, or illegible, and if time permits, redo them. If there is not time to redo them and if you can do without them, discard them. If you feel you absolutely must include visually deficient materials, know that you will need to expand your comments on those particular pieces to make up for the poor graphic quality.
- You will have one more opportunity to check the order of your visuals and the flow of your talk.
- Familiarity with the speaking environment will increase your confidence.

Transforming a talk into a good or outstanding talk takes time. There is no way around it. A lack of practice will be clear to your audience and will be interpreted as a lack of commitment, professionalism, and/or competence.

DRESS

Scientific meetings and gatherings generally permit more latitude in what is considered appropriate attire than do bankers' or lawyers' conferences. Like it or not, however, we are all judged in part on our appearance. Extremes, either too casual or too overdone, are not good ideas if you have a speaking role at a gathering.

Play it safe, use your common sense, and, remember, neatness always counts. If you err, it's wiser to err on the side of being slightly overdressed rather than underdressed.

SPECIAL REQUIREMENTS

As a matter of courtesy and to minimize on-site aggravation and inconvenience, it is wise to inform those responsible for your speaking engagement of any special needs you may have. If, for example, you use a wheelchair and need assistance to be lifted to a stage, extra maneuvering room on the stage, projection equipment positioned at a particular height or a lapel microphone instead of a lectern mike, let someone know in advance. It is generally quite simple to accommodate such requirements in advance, whereas last minute adjustments can be awkward.

VISUAL AIDS

Many public speaking experts contend that visual aids ruin more speeches than they improve. In the introduction, we noted that human beings retain best what they see and hear simultaneously. So, how is it that visual aids often fail to improve a talk?

The answer lies in the fact that there is a right way and a wrong way to prepare and present visual materials. Visual aids are vehicles for enhancing or facilitating the understanding of your spoken words. If they do not fulfill that purpose, they are misused. Visual material is properly used to give clear visual insights that would require many words or columns of numbers.

The more prevalent the use of visual aids has become, the more they are overused and misused. Improper use seems, unfortunately, to have become almost the accepted standard. Complex scientific topics often are improved by or require visual aids. But, some speakers appear to mistakenly believe it is impossible to give a scientific talk without them—lots and lots of them jam packed with barely legible data, graphs, figures, mathematics, acronyms, and fragmented verbiage—which is not the way to use the vehicle.

A visual aid becomes the focal point for the time it is in view. An audience's attention is quite naturally drawn from the speaker to anything that is put on a screen, blackboard, or flipchart. Because they automatically assume center stage, it is vitally important that all visual aids clarify and support your talk in an attractive, comprehensible manner or they will detract from it and compete with it. Another thing to keep in mind is that, for many, a darkened room is an invitation to doze. It is much easier to lose your audience when the lights are low, so be sure your visual material is compelling.

In all but impromptu talks, poorly designed, haphazardly rendered and badly edited visual aids suggest a lack of professionalism, preparation, and commitment to the audience. Poor visuals are rude and degrade the communication.

Twenty years ago, visual aids were used sparingly as slides (which now seem to be a quaint and a mostly unknown technology to younger scientists), and were costly and difficult to prepare. With the advent of color copiers and transparencies, slides were replaced with overheads. Although many speakers used these aids effectively, the quality of the visual materials was mixed, ranging from computer-generated text and prints to handwritten, scribbled text. In addition to visual quality, there were technical issues ranging from overheads being placed upside down or backwards on the projector, to curling of transparencies because of heat from the projector, among others. However, overheads provided greater flexibility for the speaker who could easily (in theory) return to earlier slides in response to questions. The reality, though, is that the overall quality of visual aids probably reached nadir as speakers cut and pasted figures from papers and books, resulting in illegible overheads. That is, visual aids became a menagerie of figures, images, and graphs developed for other media such as books and journals.

Visual aids are vehicles for enhancing or facilitating the understanding of your spoken words. If they do not fulfill that purpose, they are misused.

The quality of visual aids changed dramatically with the introduction of two pieces of technology: Microsoft PowerPoint (and its sister presentation tools for the non-PC world) and PC projectors. The early years were marked by speakers carrying both electronic versions of their talks as well as overheads in case the technology failed and they needed to revert to the standby overhead projector. As both the hardware and software environments became more robust, computer-based presentations have become the norm. Computer-generated graphics that produce dramatic on-screen projection of computer images, animations, and simulations are the accepted standards for most visual presentations. These technological advances provide exciting ways to present visual material, but with them comes the temptation to over-dramatize a presentation. The "rules" on when and how to best use visual material still apply. You want your audience to absorb and retain the substance of your talk rather than be mesmerized by your whiz-bang special effects. The more dazzling your electronic visuals are, the less important or memorable you, the speaker, are in the presentation.

THE TEN COMMANDMENTS OF VISUAL AIDS

The following "Ten Commandments" apply to any type of medium used for visual aids.

The scientific speaker should not present visual material unless it adds significantly to the spoken words.

1. Each visual aid shown must enhance, support, exemplify, and/or facilitate understanding of material covered in your talk.

The scientific speaker should not present visual material unless it adds significantly to the spoken words. For each visual piece, ask three questions. If the answer is not a definite yes to all three, redo or discard the piece.

- Will it add to my presentation?
- Does it relate to material covered in my talk?
- Is the graphic quality acceptable?

It is not necessary to produce a visual aid for every point in your talk; however, it may be difficult to discuss some points without them. Visual material is not meant to stand alone; its relevance must explained when presented in the context of the talk. By failing to explain the visual aid's connection to the material being presented, the speaker may leave the audience confused. The speaker cannot expect the audience to figure out the graphic's relevance on its own.

2. All information presented visually should be brief and concise. It must be should be presented in the most comprehensible format and edited to minimum number of words possible.

Editing visual materials to achieve the most illustrative, effective presentation requires walking a fine line between too much and too little. Do not use complete sentences, but also avoid editing the material to lists of meaningless verbal scraps. Make certain to provide all necessary references such as labeling axes and data points. A title for each visual piece gives the audience a clear idea of what they are seeing and what you will explain to them. Use the graphic tool that makes the information the most easily understood. Consider the following recommendations:

- Word charts (lists) of no more than 36 words per visual piece (maximum of six lines with six words each).
- Pie charts for percentages
- Bar graphs (horizontal) or column charts (vertical) for comparisons and rankings
- Column or line charts for changes over time or frequency.
- Bar graphs and dot charts for correlation.

3. Visual aids must be legible and clearly visible to the entire audience.

An audience gnashes its collective teeth when it hears a speaker utter the words, "I know you can't see (read) this, but it doesn't really matter. I'll show it anyway and explain." The words that follow are generally a complete waste of the audience's time. Although the speaker acknowledges that the audience cannot make out the visual material, it is explained and discussed as though it were perfectly visible and legible. If a visual aid isn't visible and legible, it isn't an aid!

Every member of the audience must have an unobstructed view of the visual material if it is to be effective. Use of the upper half to three quarters of the screen permits people seated at the rear of the room to see easily without sighting around heads in front of them. Using the upper portion of the screen for slides is even more important because the projector, projector stand, and your body may obstruct part of the lower screen. Ceiling-mounted projectors eliminate some of these issues, but sight lines must always be considered.

Use readable lettering. The recommended font size is 24 points.

PowerPoint slides generally make better visual aids than transparencies. Slides, however, must be of the greatest possible clarity and brightness to stand up well in large rooms. Magnification and distance dim the projected image and cause it to lose clarity. The further the projector is from the screen, the greater the order of magnification, thus the greater the loss of clarity and brightness of slides. The larger the room, the greater the need for bright, clear slides. Computer-generated graphics generally hold their quality well with magnification and can exhibit much greater brilliance.

In those rare instances where you must use handwritten transparencies, use block letters, not script (cursive). And, please, use your best penmanship. If your handwriting is dif-

ficult to read, it will not be any more legible magnified many times. Again, anything with which the audience must struggle is distracting and annoying, so you might consider having someone else write them for you, or have them typed.

In today's high-tech world, flip charts and black (white) boards are used most frequently in the classroom, but occasionally they are all that is available for small groups or impromptu talks. The following chart provides a quick reference for the lettering size to use for distances from the board or chart to the last row of the audience:

- 1-inch (2.5 cm) letters for 30 feet (9 meters) or less,
- 2-inch (5 cm) letters for 30-50 feet (9-15 meters), and
- 3-inch (7.5 cm) letters for over 50 feet (15 meters).

Experts also offer these formatting tips to increase the legibility of your visual aids:

- Left-justify the copy, leaving the right margins ragged. Fully justified (equal right and left margins) text makes it more difficult to distinguish each line and to differentiate between points.
- Use a uniform, bold typeface.
- Sans-serif and computer-generated bold, serif typefaces enlarge well, whereas serif typewriter copy (generally Courier in the United States) does not.
- A combination of upper and lower case is more easily read from a distance than all upper case.
- Use larger type for headings and smaller type for subheads to show relative importance.

All you can hope to inspire in your audience with illegible, confusing visuals is annoyance, skepticism, and questions about your competence and professionalism.

4. Two or three facts or information points per image are best; six are considered the absolute maximum.

The more complex the points, the fewer that should appear on a single visual piece. At times it may be necessary to use a complicated image. Instead of presenting the audience with a complex visual all at once, build it up, layer by layer. To keep the audience with you, add information incrementally by using a succession of slides. Creative use of color as information assists audience comprehension as you build to the final image. However, clever or cute "build" tools found in presentation tools such as PowerPoint are distracting and ultimately wearisome for the audience as they wait for the slide to be completed. Thus, you should use these tools sparingly.

5. Do not load too much visual material into a talk.

Depending on the complexity of the material, use of three to six images per 10 minutes is usually optimal. More complex information takes more time to absorb, so reduce the number of visual pieces presented accordingly.

Editing visual materials to achieve the most illustrative, effective presentation requires walking a fine line between too much and too little.

6. Use color for emphasis, distinction, and clarity.

Use of color in visual aids dramatically improves retention of information. Highlighting headings and key points, and color-coding graphs and charts is good, functional use of color. Using color for aesthetic value is acceptable unless it interferes with or detracts from absorption of the visually presented information, which happens when visual aids become too colorful or colors are too randomly placed. Use color for effective visual impact, but resist the temptation to over-colorize.

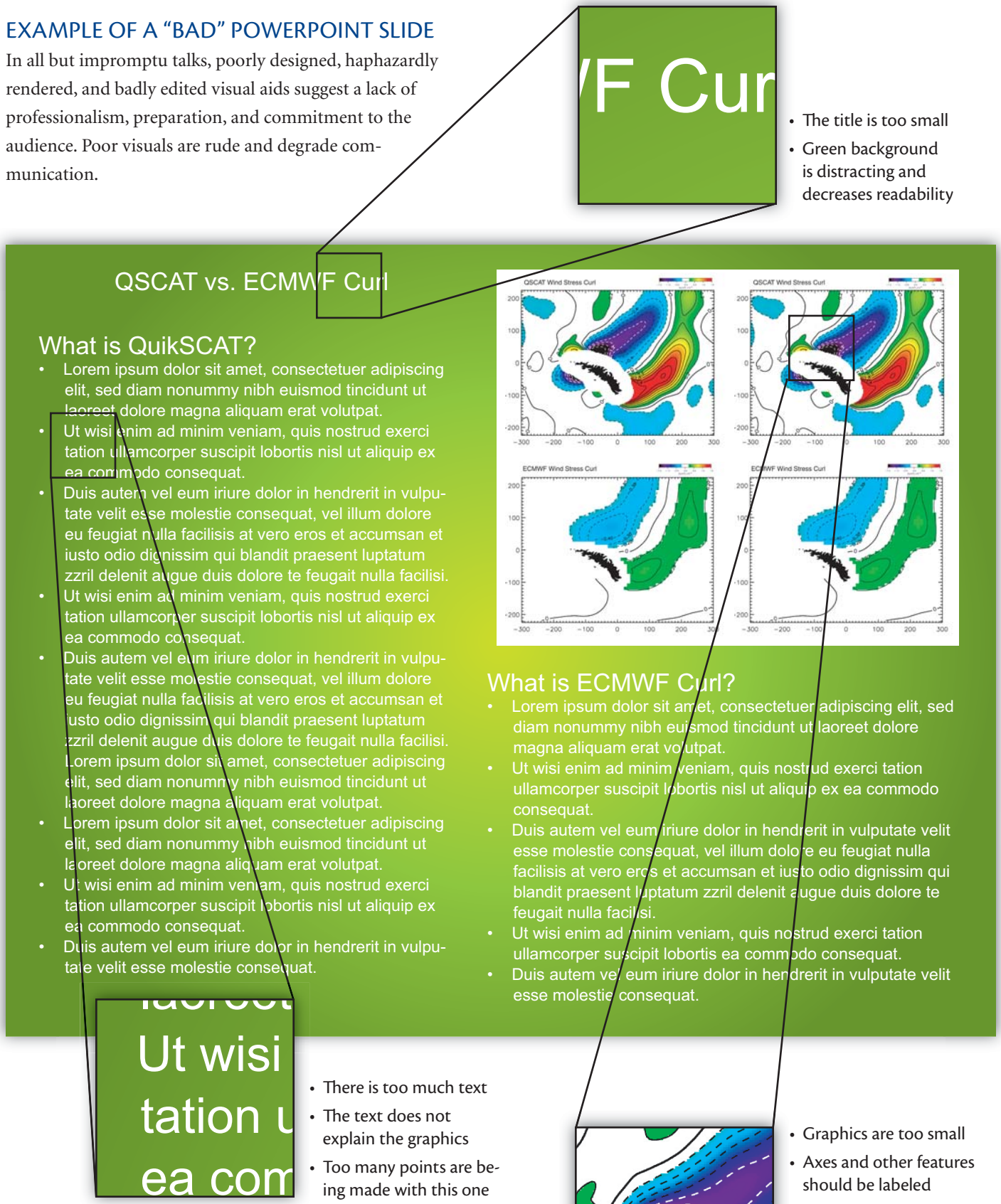
Be careful with colored backgrounds because some colors can make black figures or text less distinct. Yellow and bright blue are good background colors; dark blue and red usually are not, unless the figure or text is reversed to white.

In using color, it is important to remember that magnification reduces brightness and clarity. Colors grow muddier the more a visual piece is magnified. Because slides and transparencies are all magnified to some degree, use the most vibrant colors possible. One of the best ways to brighten a color is to place it next to or surround it by its complementary color.

- Blue with orange,
- Blue-violet with yellow-orange, and
- Violet with yellow.

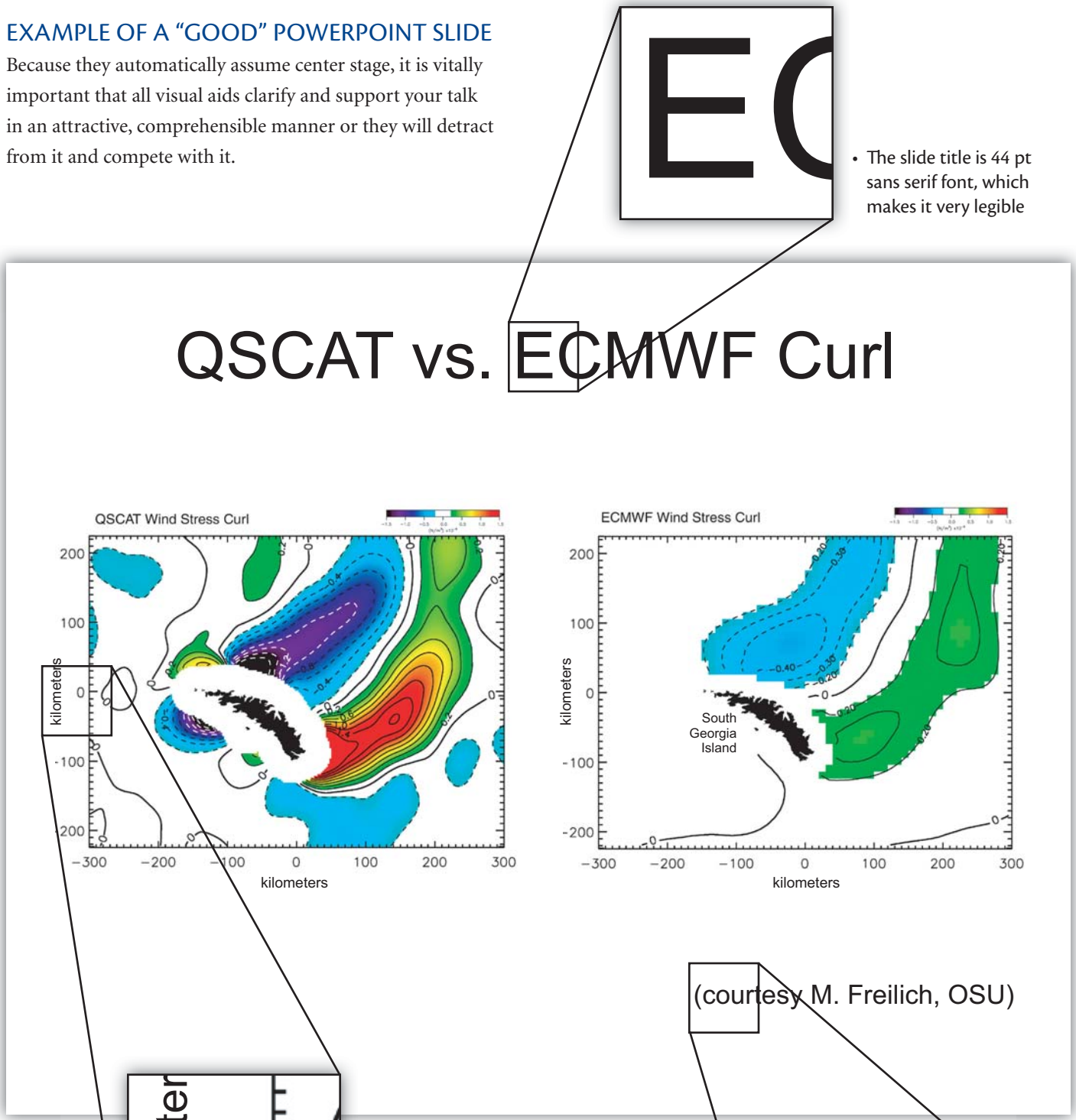
EXAMPLE OF A "BAD" POWERPOINT SLIDE

In all but impromptu talks, poorly designed, haphazardly rendered, and badly edited visual aids suggest a lack of professionalism, preparation, and commitment to the audience. Poor visuals are rude and degrade communication.



EXAMPLE OF A "GOOD" POWERPOINT SLIDE

Because they automatically assume center stage, it is vitally important that all visual aids clarify and support your talk in an attractive, comprehensible manner or they will detract from it and compete with it.



- The slide title is 44 pt sans serif font, which makes it very legible
- Only two graphics are used
- Axes are labeled and readable
- Person who provided the data is acknowledged

Approximately 10% of the male population is color blind and red-green is the most common type of color blindness. Please notice that the above list omits the red with green combinations of the color wheel. If possible, avoid those complementary color sets in your visual material to accommodate as many in your audience as possible.

7. Do not read your visual aids to the audience instead of giving a talk.

First, the audience can read faster than they can hear you read. Second, if you are reading the screen, your back will be to the audience and part of a speaker's job is to face the audience. Third, if your visual aids contain most or all of your talk, you should probably have prepared a handout and relinquished your time at the lectern.

The desired style in scientific talks is to speak conversationally and confidently. It is perfectly fine to use your visual aids as notes for your talk, but reading a talk, whether from sheets of paper at the lectern or from images on a screen, is not the preferred presentation style in scientific circles.

8. Be aware of the "life span" of each visual piece.

The moment a visual piece is presented, the audience's attention is drawn to it. Display a piece of visual material only when you are ready to talk about it and do not leave an image to "die" on the screen.

The two factors that determine the life span of a visual aid are the time necessary for the speaker to discuss it and the time needed by the audience to absorb the information. More complex concepts and mathematics take longer for both parties, so be sure to allow extra time for them. It is frustrating to an audience to get only a brief glimpse of a visual piece before the next image is flashed on the screen. On the other hand, the audience's attention drifts if an image is left on the screen and the talk has moved on to new information. Remove each visual piece when your talk has progressed past that material; as long as an image is before them, at least part of the audience's attention will be on the screen.

If you present a new image for your next point while you are still speaking about the previous point, the audience will move ahead of you to the new material. Covering part of the information on a slide until you reach that point in your talk is extremely annoying to an audience. If you need more than a minute between portions of a single slide, break the information into separate slides to keep the audience with you and focused on what you are saying.

The smooth, effective use of visual materials requires practice and a bit of choreography.

9. Rehearse your talk with your visual aids.

The smooth, effective use of visual materials requires practice and a bit of choreography. Bumpy verbal transitions and awkward handling of slides will grab part of the audience's attention, thus lessening the impact of your talk. Rehearsing with your visual material will help keep you from getting sidetracked and losing your place in your talk.

Unless you are going for high drama, do not open or close your talk with a visual aid. After taking the podium, establish yourself with the audience and settle yourself down, then dim the lights and show your first visual piece. Practice talking while changing visual materials to avoid losing momentum, your own train of thought, and the audience's attention. Make certain that the correct visual piece is on the screen after each change before you continue.

Perhaps the most difficult steps to remember in using slides are to (1) move aside after the image is projected so the audience can see the entire screen, (2) point to the information on the screen, then (3) turn back to the audience to speak.

It is important to explicitly point to the information on the screen that you are discussing. Do not assume the audience will find it on their own. Point to it and tell why it is important. Rehearsing will enable you to maintain your train of thought as you turn from the audience to the screen and back again.

10. Prepare visual aids that can be accommodated by the technology on hand and the speaking environment.

You, as the speaker, have the ultimate responsibility for learning what audiovisual equipment will be available and/or to request the equipment you will need. Ordinarily, after you accept an invitation to speak, you can expect to be

informed of the pertinent details, but if they are not forthcoming, ask questions:

- What equipment will be available? Will you need to specially request or order anything? (If showing a videotape, make sure the tape size and the equipment are compatible.)
- How many screens and how large?
- What is the size of the room and how will it be arranged?
- Where will the lectern be placed?
- Does the lectern have a light? It's difficult to read your notes without a lectern light in a room darkened for visual presentations.
- How many and what type of microphones?
- Will an audiovisual technician be on hand during your presentation? If not, who will handle emergencies? Are there extra projector bulbs on hand and where are they?
- Will a technician operate the projector or will there be a remote control for the speaker to use?
- Who will monitor and adjust the lights?
- What type of pointer will be provided?

All these factors together determine how you prepare and present your visual aids. Failure to learn those details in advance can lead to unpleasant surprises, if not outright disasters. Never assume that all the equipment you plan to use will be waiting for you unless you have discussed it (and even better, verified it in writing with the organizers of the meeting, the person responsible for your invitation or the venue's audiovisual staff). Even if your requirements have been confirmed in writing, it is up to you to check that everything is actually there when you arrive at the site.

ELECTRONIC PRESENTATION PITFALLS

Most scientific meetings now require electronic presentations, although they may reluctantly provide an overhead or slide projector. Similarly, most academic facilities provide PC projectors for seminars and lectures. For some meetings, advanced submission of the talk is required in order to accommodate hundreds of talks and dozens of meeting rooms. This means that the visual aids must be locked in several days to weeks in advance of the presentation. Some meetings allow you to walk in with a memory stick and load the presentation minutes before the start time. In between these extremes are meetings that provide speaker ready-rooms where you can review and revise your presentation that was submitted in advance.

All of these approaches have impacts on how you prepare your presentation. The advanced submission approach may limit your ability to make corrections or updates. Therefore, you must be especially well organized, something that is often difficult for a busy scientist trying to juggle research, teaching, and administration schedules. Most of us procrastinate and develop talks the week (or night) before. However, the rigor of a deadline might encourage us to plan and practice, which can only improve the quality of our talks. On the other hand, last-minute revisions can be made that build on information presented by other speakers if the talk is given as part of a scientific meeting or is on new results. In general, though, last-minute revisions lead to disorganized and scattered talks as the material is as new to the speaker as it is to the audience. Gazing in wonder or confusion at a new slide and developing on-the-fly interpretations at the podium are not especially compelling.

Along with the Ten Commandments that are applicable to all visual aids, there is a Bill of Audience Rights when speakers use presentation software and PC projectors.

1. No speaker shall use his/her presentation as a dry run of hardware and software.

Nothing deflates an audience more than when a speaker cannot get their presentation loaded or running. Watching a group of scientists hover around a PC and projector is a sure way to lose an audience's attention (and also eats into your allotted presentation time). Incompatibility of graphics programs may lead to unexpected failures in the middle of a talk.

In particular, Macintosh-based graphics are often incompatible with Windows-based software, resulting in a large red "X" where the speaker had expected a compelling graphic. Animations are often the most troublesome in terms of portability between operating systems. Don't just test your Macintosh-based presentation on a local Windows machine; test it on the actual machine that will be used for the presentation.

Determine whether you will be using a computer provided in the meeting room or if you will be hooking up your machine to the PC projector. Each option brings its own set of challenges. If you use the meeting-room computer, ensure that you have the appropriate hardware to load your presentation onto the computer. USB memory sticks are the most common, but sometimes speakers use incompatible versions, such as USB 2.0, when the machine can handle only USB 1.0. Generally, meeting-room computers are not the latest in regards to either hardware or software, so using "old" hardware and software is often the safest choice. You can avoid some of these problems by using your own PC to run the presentation. However, synchronizing your PC with the projector is not always straightforward. Many times you will need to change the display resolution and the refresh rate of your PC to be compatible with the resolution of the projector. Otherwise, your slides may be cropped or not displayed. So, test your entire presentation first and become familiar with the operation of your PC so that you can make any necessary configuration changes.

2. No speaker shall use his/her presentation as an opportunity to learn about computers.

If you are going to use advanced technology, it is always a good idea to understand it first. Read the manuals! Understand how to navigate through your presentation if you need to go back to an earlier slide in response to a question; do not simply just skip back through every slide! Understand how to launch your presentation. Create a presentation version that launches automatically, rather than launching the presentation software and then launching "slide show" mode. A presentation is not the time to learn about hardware and software.

Meeting rooms are increasingly high tech, with computerized lights, window blinds, etc. If you find yourself in such a room, make sure that you are familiar with its operation.

3. Every member of the audience has the right to be the focus of attention by the speaker.

Although this point has been previously listed as Commandment VII, it is repeated here because presentation software seems to encourage this particular sort of bad behavior. Perhaps because it is easy to put lots of text on a slide, many speakers find themselves reading the slides. This is a sure way to make the audience ask itself why it is there. Moreover, you become a narrator or a disembodied voice, rather than a speaker. This effect can be amplified if the sound system fills the room with your voice without a providing a sense of where you are physically located. Without eye contact, you have severed your relationship with the audience, and they become passive as if watching television or a movie.

Another common piece of technology is the laser pointer (often integrated with a remote control to advance the slides), which focuses your attention on the slide, rather than your audience. Rapid waving of a bright red or green dot, an inability to point steadily at a desired location on the slide, and a tendency to blind one's audience inadvertently while waving a laser around the room are among the reasons to approach the use of the laser point with great trepidation. If your slides are well designed, the audience will not need to "follow the bouncing ball."

4. The use of sophisticated technology does not overrule the Ten Commandments for the use of Visual Aids.

Although the rules for visual aids were designed primarily with photographic slides in mind, the use of presentation software and PC projectors must follow the same rules in regards to layout and design: in fact, the relatively low resolution of the most commonly used presentation graphics formats makes even stronger demands on legibility of labeling.

5. The intellectual rights of your colleagues to their original research must always be respected and acknowledged.

With more material now available on the Web, rapid transmission of knowledge and graphics via e-mail, and the use of search engines to locate digital material, it is a simple matter to grab figures, text, and other material to fold into your presentation. This ease of access comes with a number of problems. First, the quality of graphics downloaded from the Web is often very poor, degrading the quality of your presen-

tation. However, the more serious problem is often that of intellectual attribution. Although embedding other scientists' work within your own talks may well be appropriate, the provenance of particular electronic graphics can be easily lost through multiple transfers/downloads. Correct attribution of sources may become difficult or impossible, and there is a very real risk of an audience member seeing their work up on the screen without any acknowledgment. Because much of science proceeds through logic and history, routinely divorcing scientific results from their origins will ultimately cripple the scientific method. There is only one safe rule for using the scientific results of others in your presentations: *if you can't supply an accurate attribution, don't include the material.*

6. The audience has the right not to be subjected to "PowerPoint Phluff."

A recent booklet by Edward Tufte (*The Cognitive Style of PowerPoint*, which can be purchased at www.edwardtufte.com) is required reading for every speaker who relies on presentation software. Presentation software can be useful for organizing talks and showing a diverse set of graphics, but the tendency is to use many of the other capabilities such as flying clip art and complicated build sequences to create what Tufte calls "PowerPoint Phluff." The late Neil Postman in his book *Technopoly* described print as emphasizing logic, sequence, history, and objectivity. In contrast, television emphasizes imagery, narrative, presentation, and quick response. Clearly, science and print are natural partners. But many computer presentations of science increasingly resemble television where the medium is more important than the message. The overproduction of talks is something to be resisted.

7. No speaker shall use presentation software to transform scientific discourse into a computer programming and marketing tool.

Tufte notes that the hierarchical, bullet format used by presentation software is appropriate for the one-line-at-a-time, sequential thinking required to program a computer. And the fast pace and emphasis of form over content is characteristic of marketing. Hierarchical lists of bullets do not show critical relationships among the various elements, except for priority, sequence, and membership in a set. More importantly, a bullet list leaves out important assumptions about relationships. For scientific presentations, such simplistic lists of nested bullets can be deadly. They suggest a simplistic level of scientific thinking and inference. Tufte goes further and states that presentation software is analogous to a voice mail menu, and it establishes a dominance relationship between the speaker and the audience. However, our presentations should be viewed as teaching where explanation, reasoning, evidence, questioning, and content are more important. How can we hope to express complex scientific ideas and findings on a one-page list of nested bullets? Software templates impose their own structure on a talk, which is often not appropriate to convey complicated data sets and complex ideas. The result is that the speaker relentlessly follows the outline, and the audience tries to fill in the blanks, or worse, becomes passive.

Nothing deflates an audience more than when a speaker cannot get their presentation loaded or running.

Presentation software can be valuable as a slide organizer and to display low-resolution materials. These tools are especially well suited for imagery, such as that produced by satellites and computer models. However, the speaker should use text slides only to highlight key points, especially in the summary. Rely on your narrative to connect the graphics and data together into a well-articulated presentation. Your audience will then focus on you, rather than on your lists of bullets.

8. No speaker shall use presentation materials in place of a paper.

It is becoming commonplace to "publish" PowerPoint slides to the Web in place of papers. Not only does this raise issues of intellectual property, but it seriously diminishes the quality of scientific discourse. Refereed publications remain the gold standard of the scientific community. Their replacement by a set of slides published on the Web raises many troubling issues.

DELIVERY

Studies of interpersonal communication show that:

- 55% comes from facial expressions and body language
- 38% comes from vocal quality or tone of voice
- 7% comes from content, the actual meaning of the words.

Scientifically trained audiences will probably absorb somewhat more than the general population from content and a little less from the other two factors. Even considering a more sophisticated audience, however, the numbers clearly show that nonverbal signals speak volumes and are important in getting your message across. To be most effective, the scientific speaker needs to develop a delivery style that incorporates good body language, pleasant facial expressions, and a confident, yet relaxed, tone of voice.

Use a well-modulated speaking voice and a conversational tone. Practice using a microphone with someone in the room to help you find your best public speaking volume. Speaking either too softly or too loudly conveys inexperience. Speak clearly and distinctly. Speaking too quickly portrays nervousness (if not terror) and a lack of self-confidence.

Make eye contact with members of the audience. Use the visual feedback you get from them to assess how your talk is being received. If they seem to be drifting off, pick up the pace. If they seem confused or unsure, slow down and repeat important points. Try to have your eyes on the audience 90% of the time you are speaking, particularly at the opening, the closing, and the end of each emphasized statement.

Smile. A smile at the opening and here and there in your presentation sends a powerful nonverbal signal to the audience that you are comfortable, self-assured, and in control. An occasional smile will help you to relax and will increase your rapport with the audience. But the smiles must be genuine and at appropriate times in your talk.

Vary the pace of your words. Pauses are essential to a strong delivery. Pause after the introduction of a new key point and after displaying a new visual to give the audience a chance to make the transition.

Watch your posture. Standing rigidly or gripping the sides of the lectern tells your audience that you are far from relaxed and confident. Draping yourself over the lectern is too informal and conveys indifference. Gestures add emphasis to your words and can even provide an outlet for nervousness, but use them judiciously. Too many and too flamboyant gestures detract from what you are saying. And keep your hands out of your pockets.

The thing to remember is that, while you are speaking, you are in charge of the gathering. You control the pace and the tone. You must gain the audience's confidence and capture its attention. It is up to you to interact with the audience and assess its reaction to your presentation. You are responsible for staying on schedule. You are presiding.

Q & A POINTERS

It's not enough that you made it through your talk. Now you must subject yourself to cross-examination and do so while thinking on your feet. Q & A sessions can definitely be tricky, but remember, while you are at the podium you are in charge. You can and must control the exchanges. Experienced speakers offer the following thoughts to help you avoid or defuse awkward situations, keep the questions on track, and enable you to maintain your poise, dignity, and control of the session.

1. To encourage your audience to ask questions, call for them in a way that suggests you expect and want them.
"What questions do you have?" is an active solicitation whereas "Any questions?" is rather unconvincing. If you have

a lapel or corded microphone, come from behind the lectern for the Q & A session. This is the most interactive part of your presentation, so eliminate the barrier of the lectern. The audience needs a moment or two to make the transition from listening to speaking, to formulate their questions and, in some cases, to get up the courage to ask a question before the audience. Wait a minute or so and if no one asks a question, ask one yourself. That will generally get things rolling.

2. Always repeat or restate a question from the floor.

Even in small groups, a question from the front row may not be heard at the rear of the room. In large rooms, it is essential even when floor microphones are provided for questions.

- Repeat all positive questions. This makes certain everyone heard the question and buys you a moment or two to compose your response.
- If necessary, rephrase the question for clarity.
- Paraphrase negative questions. By changing the slant or tone of the question, you can respond positively.

3. Respond simply and directly.

Don't allow yourself to get sidetracked or to ramble. That consumes the time for other questions and gives the impression that you are not entirely sure of the question or the answer. If short, simple answers are not adequate, tell the audience you will make yourself available after your talk to answer in more detail.

4. Don't bluff.

If you don't have the answer, say so. Then amplify: "Those data won't be available for several months," or "Sorry, that's outside my area of expertise." Then offer a helpful solution: "I'll find out and get back to you" or "That's Joe Smith's field. See me later and I'll tell you how to contact him." Virtually no one has all the answers all the time. It's helpful, therefore, to compose a short mental list of responses that say, "I don't know," so you won't get flustered and lose your composure.

5. Don't lose your cool.

Never respond defensively, with irritation, or with anger. Such responses show that you have lost control of yourself and your presentation. Train yourself to resist the impulse to fight back or put down the questioner with a snappy reply when a hostile, negative, or belligerent question comes from the floor. If the question can be restated positively, do so, answer it, and move on. If not, firmly, yet diplomatically, state that this is not the time or place for that debate, but offer to discuss it after your presentation. Then move on.

...remember, while you are at the podium you are in charge. You can and must control the exchanges.

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6. If someone asks about something explicitly covered in your talk, answer anyway.

Perhaps you did not make the point clearly enough. This time, try another approach. If, for example, you covered the point in your talk with graphs and charts, respond to the question with a summary of the most important data covered in the visual material. If your talk progressed step-by-step to a conclusion, in response to a question you might begin with the conclusion and work backwards.

7. If someone repeats a question that's already been asked, the general guidance is don't answer it again.

"I believe we've already covered that" usually works. On the other hand, if the second question indicates that your first response was inadequate or confused the audience, do take another stab at it.

8. If someone tries to turn a question into a long-winded speech, politely, but firmly, stop him or her.

First, raise your hand. Most people will respond to this nonverbal signal to stop speaking. Then, you might say: "To have time for the other questions and so the audience will be clear on what you're asking, would you please give us your question now." The audience will appreciate this indication that you are responsibly controlling the session and that you value their time.

9. If someone asks a totally irrelevant question, respond by saying that really is not part of your topic.

However, (if you're feeling generous) you could say: "It sounds like an interesting subject."

10. The speaker can give permission for short interruptions, "for the purpose of clarifying a point or figure," especially with a smaller audience.

Carefully prepared talks and good visuals, however, will lessen the need for such interruptions from the audience. If an interruption is for more than a quick point of clarification, ask the individual to please hold the question for the Q & A session.

11. If you run out of time, apologize for being unable to take every question. Offer to make yourself available after your presentation.

12. Give a short statement to close your Q & A session, then thank your audience for their questions and interest.

HANDOUTS

Handouts are not customary in scientific meetings. However, for presentations in other settings, for example, committees and advisory boards, they may prove advisable due to the complexity of scientific topics or the time allotted for the presentation. Handouts can reinforce important information, provide summaries and reading lists, and supply supporting data, such as detailed relational or organizational information, that would be difficult or unnecessary to present within your talk.

You can distribute handouts before, during, or after your talk. There are advantages and disadvantages to all three so you must consider what you hope to accomplish with the information provided to determine when to give it out.

If there is material in your talk that does not lend itself to visual display on the screen, but that is important to follow while you speak, distribute the handouts before you begin speaking. If possible, have them in place when the audience enters the room. This will allow them to read the information before you begin speaking. People who are reading are not fully listening, so if your printed materials cannot be distributed until you take the podium, wait a couple of minutes while the audience looks over the information before you start to talk.

Distributing handouts during your presentation is tricky. If you are certain they are essential to the point you are discussing, pass them out quickly, but realize that no matter how quickly the distribution is accomplished, the audience will be distracted and you will lose some of your momentum. This is the least favorable time to distribute materials, but occasionally it is the only appropriate time to do so. Just be aware that you will have to recapture your audience's attention and get yourself back on track.

If you decide to distribute the printed materials after your talk, let your audience know during your presentation. Tell them what information is covered in the handouts, which will encourage them to listen instead of dividing their attention by taking unnecessary notes.

IMPROMPTU TALKS

Many impressions and decisions are made based upon impromptu talks at meetings and conferences, in the classroom, and in daily conversations. You can learn to think on your feet and become at least an adequate extemporaneous speaker. If you are frequently or even occasionally called on for impromptu remarks, the exercises necessary to develop the skill are worth the effort.

As mentioned in the introduction, one of the focuses of this publication is on the invited talk for which you have time to prepare. Clearly, much of the advice is not applicable or must be substantially abbreviated for impromptu talks. Some of the suggestions, however, can be used on the spur of the moment, especially if you have become familiar with them in the context of preparing and delivering invited talks. You

can do a quick assessment of the audience by simply looking around the room. You can organize your remarks by making a quick mental outline or, if time permits, jotting down a few notes. You can incorporate many of the elements of good delivery. And it is possible, with practice, to train yourself to do a commendable job of ad-libbing with less than Mr. Twain's recommended three weeks preparation time.

There are two types of extemporaneous speaking situations: times when you choose or feel compelled to contribute and times when, out of the blue, you are called on to contribute. The latter is, by far, more difficult. But there are a few tricks to help you with both situations. The problems with impromptu talks for most people are their inability to organize their thoughts quickly and coherently and to know when to stop talking. There are several patterns to keep in mind that will help you formulate a fast mental outline.

- A chronology: past, present, and future.
- By topics 1. 2, and 3 (it is recommended that you limit yourself to three unless you have had time to make a few notes).
- A discussion of the pros and cons.

Your mental outline should include your conclusion—the primary message you want to leave with the audience, presented as a strong, positive statement. Inexperienced extemporaneous speakers often simply forget a closing statement and just stop speaking. Resist the temptation to ramble; say what you have to say and either sit down or call for questions.

If called on unexpectedly to "say a few words," stall for a moment or two to collect your thoughts by thanking the chair or speaker for giving you time to speak and possibly reiterating something said previously. Asking a rhetorical, yet relevant, question is also a way to buy a little time and can serve as your opening.

Practice in spare moments by picking a topic, taking a minute to prepare a mental outline or make a few notes, then standing and speaking for a couple of minutes. Increase the speaking time as you become more comfortable with the exercise. A practice shortcut is to make quick mental outlines of topics while reading the newspaper or watching the evening news. In training yourself to speak extemporaneously, the thought-gathering process and the speedy organization of those thoughts are the keys; the topic is almost incidental.

ADDRESSING A NONSCIENTIFIC AUDIENCE

As with addressing a scientific audience, when speaking to a lay audience or the media, the point is to clearly and concisely communicate your information on a level they will understand. The point is not to overwhelm or snow the audience, nor to impress them with your vast knowledge and lofty credentials.

Effectively communicating with such a group usually means greatly simplifying a complex topic. There are some important guidelines that will help you with that task.

- Be sure to give at least thumbnail sketches of any essential underlying assumptions or principles, then straightforwardly explain or demonstrate how they relate to your subject.
- If possible, frame your talk in the context of everyday life or the binding focus of the group you are addressing.
- Math is rarely, if ever, appropriate for this type of audience
- Talks given to other scientists usually include caveats, "on the other hands" and manipulation of variables because they indicate thorough and multidimensional research. Try to avoid those mechanisms when addressing a nonscientific audience because they tend to obscure your point(s) and confuse your listeners.

Confusing a lay audience is bad enough because it essentially wastes their time by failing to provide new, comprehensible knowledge. Confusing media representatives, however, can have farther-reaching consequences, including being misquoted and made to sound foolish. Keep your remarks simple, direct, and well grounded in scientific fact.

Practicing your talk before a rehearsal audience of approximately the same age and educational level as your real audience is an excellent means of testing whether you will get your message across clearly. Does she understand everything? Does he need more background information? Does she have ques-

tions? Does he understand why the topic is important? Add to and subtract from your talk according to the responses.

A big problem for scientific speakers arises when addressing a combined group of experts and non-experts. As an expert, it is insulting and a waste of time to be "talked down to;" as a non-expert, it is frustrating and a waste of time to be subjected to a talk that is beyond one's level of comprehension.

To strike a happy medium in such a situation, try to accommodate both levels of understanding with a carefully crafted compromise from which everyone gains something. One useful suggestion is to devote half to two-thirds of your time to an introduction or overview of your subject and save the highly technical material for the remaining time. Non-experts understand and learn from the first part and experts comprehend and are attuned to the technical information. Experts may also gain new insights on how to present the subject to non-experts.

Another useful approach is to give the more involved technical material, then to summarize with "in other words..." or "by analogy..." when you restate the information in simplified, plain English. These brief summaries should be done throughout the course of your talk and often enough to prevent those not following the technical information from drifting off.

CONCLUSION

The intent here has been to present positive suggestions to help scientists develop or fine-tune their public speaking skills. Where "thou shall nots" appear, they are important because they reflect complaints heard repeatedly about public addresses in general and scientific talks in particular. Each "don't do this" is supported by a rationale and, in most cases, followed by recommendations on how to do it better.

Capturing, focusing, and maintaining an audience's attention are the keys to giving a good talk in any situation. There are many references here to things that annoy, confuse, and distract audiences because a room full of annoyed, confused, or distracted people will not be receptive to or retain what you have to say. There are, of course, external factors that can affect the audience's concentration such as faulty audiovisual equipment or noise from outside the presentation room. The message here, however, is to point out some of the many things speakers do themselves through inexperience or carelessness, that undermine their own talks and to offer insights on how to avoid those pitfalls.

Common sense plays an important role in preparing and giving a good scientific talk. Scientists have ample opportunities for comparison of good and bad talks. It is a serious matter to complain about the rambling, disjointed talk of a colleague and then give one yourself. The same is true of hastily prepared, illegible visual aids. You recognize what makes a talk good when you are in an audience, just as you recognize what makes a bad one. Take the time to develop the skills necessary to emulate the good ones and avoid duplicating the mistakes of the bad ones.

We hope this publication will assist with both efforts.

FOR MORE INFORMATION

In addition to this booklet and the following print references, many valuable sources of advice on public speaking are now available on the web.

- Anholt, R.R.H. 1994. Dazzle 'em with Style: The Art of Oral Scientific Presentation, W.H. Freeman and Co. New York. 200 pp.
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